Jet Veto Efficiency Study on Data using Zs

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H→WW Working Meeting
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Outline

- Overview of the JetVeto signal efficiency and systematics
- JetVeto efficiency calibration on data using Zs
  - Dataset and Z selections
  - Jet Et spectrum and JetVeto efficiency for jets with $3<|\eta|<5$
    - Jet Et spectrum and JetVeto efficiency for jets with $|\eta|<5$
      - Results based on the uncorrected jets
      - JEC correction effects on the results
- Estimation of the JetVeto signal efficiency of WW
- Summary and plan

Jet Veto Signal Efficiency

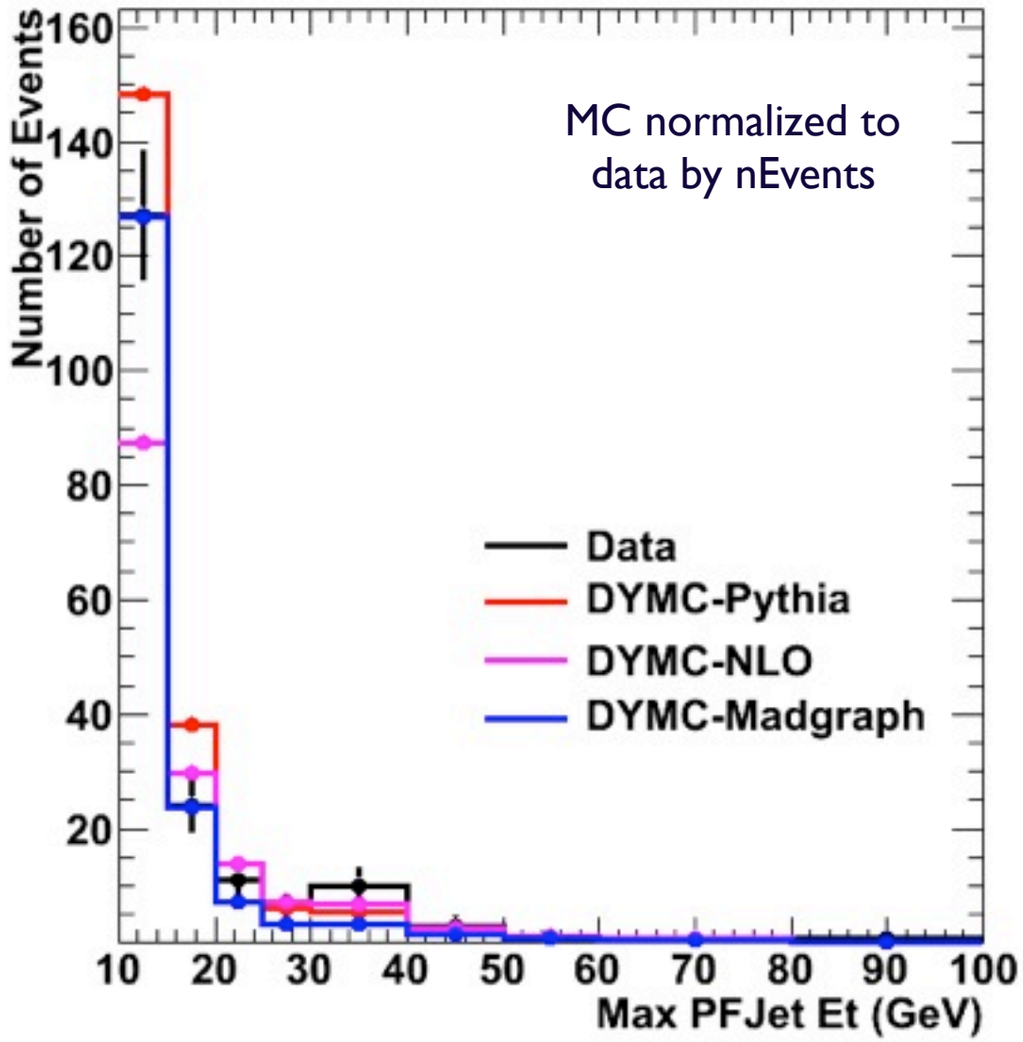
- Jet Veto is main handle to suppress top-background
  - New Proposal (conservative working point):
    - Max Jet Et < 25(20) GeV $|\eta|<5(3)$
  - The systematic error on jet veto signal efficiency is one of the main sources of the systematic errors in signal efficiency and cross-section
  - ISR Jets (especially the low pT ones) are difficult to predict in theory
- We have to rely on MC at certain level, with "data-driven" method* for systematic errors (<10% as a goal)
  - Use the Z+Jets as a control sample to see the Data/MC matching
  -

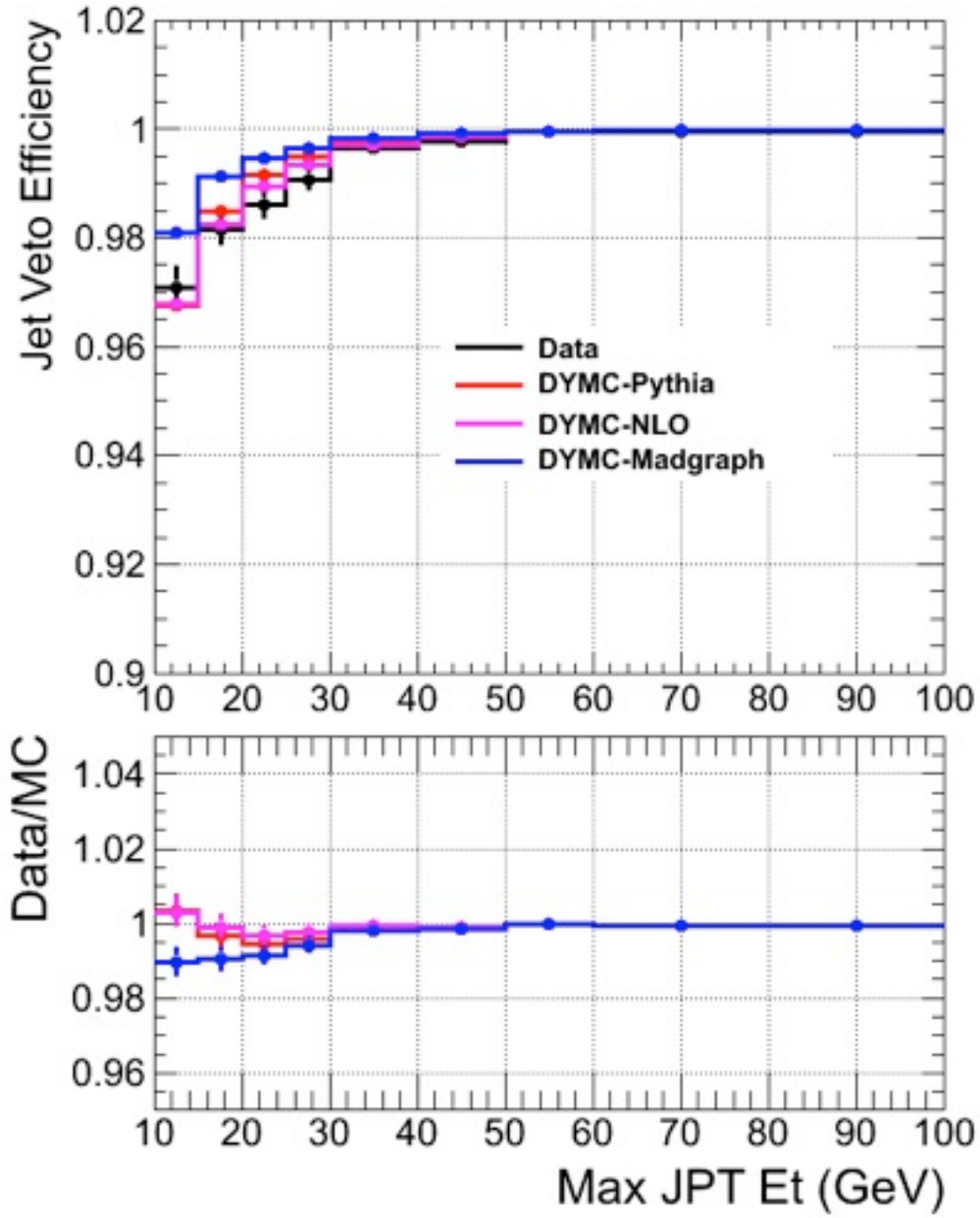
*Previous talk: http://indico.cern.ch/getFile.py/access?contribId=3&resId=0&materialId=slides&confId=89930

Datasets and Z Selection

- Data 3.1/pb with the goodruns list provided on 09/11
- MC (ll: ee + mumu)
  - Pythia: /Zll_Spring10-START3X_V26_S09-v1/
  - Madgraph: /ZJets-madgraph_Spring10-START3X_V26_S09-v1/
  - NLO: /Zgamma_ll_M20-mcatnlo_Spring10-START3X_V26_S09-v1/
- Z selection differences from WW reference
  - |M(ll)- 91.1876| <15 GeV in EE/MM
  - If multiple hypo. are found, choose the one with m(ll) closest to Z mass
  - Relax all JetVeto and MET cuts
  - Relax all trigger selections
  - Relax softMuon and third lepton vetos
- Number of Events after the Z selection: 629 (EE) 1109 (MM)

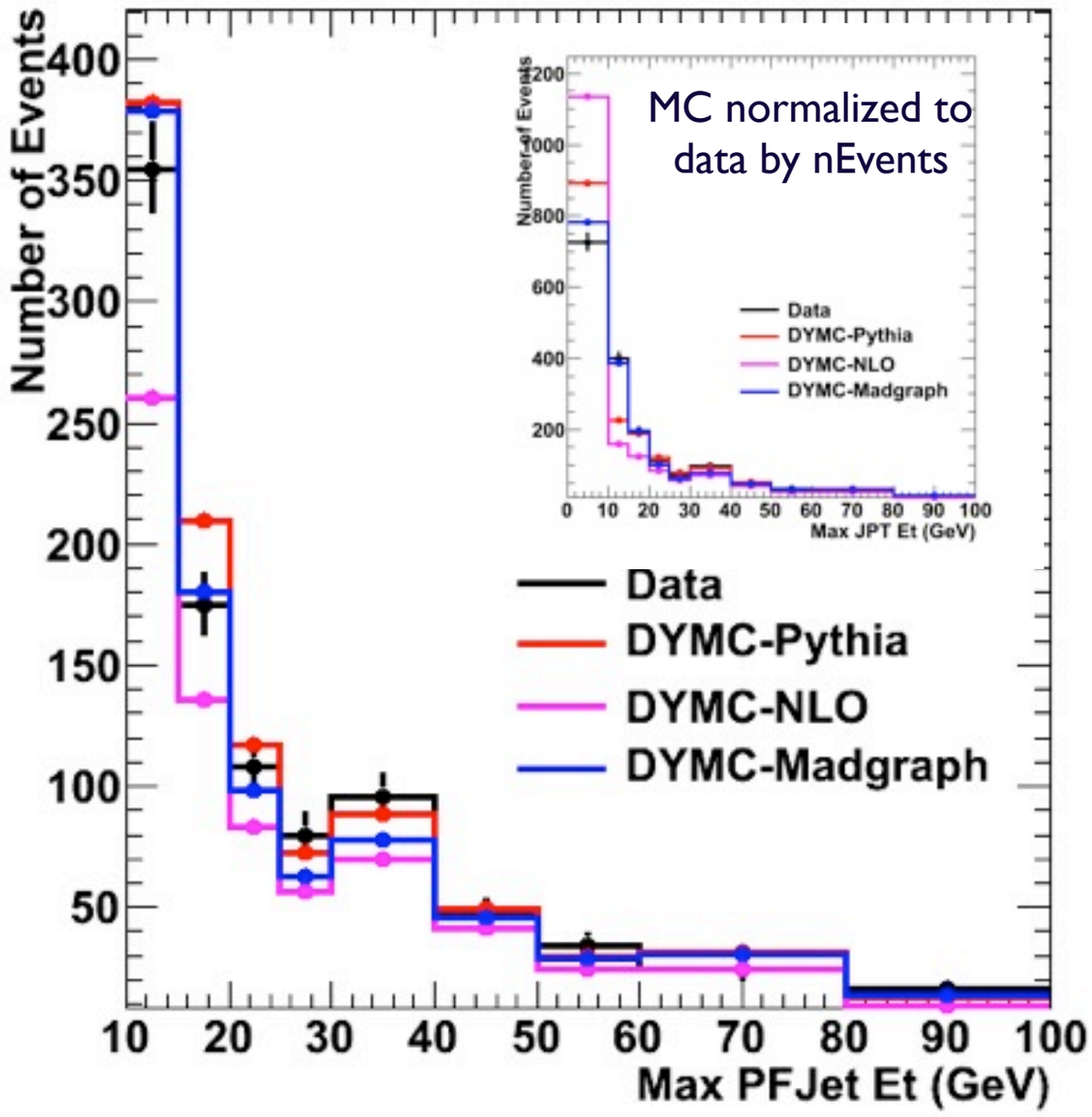
PF Jets 3|<η|<5 (EE+MM)

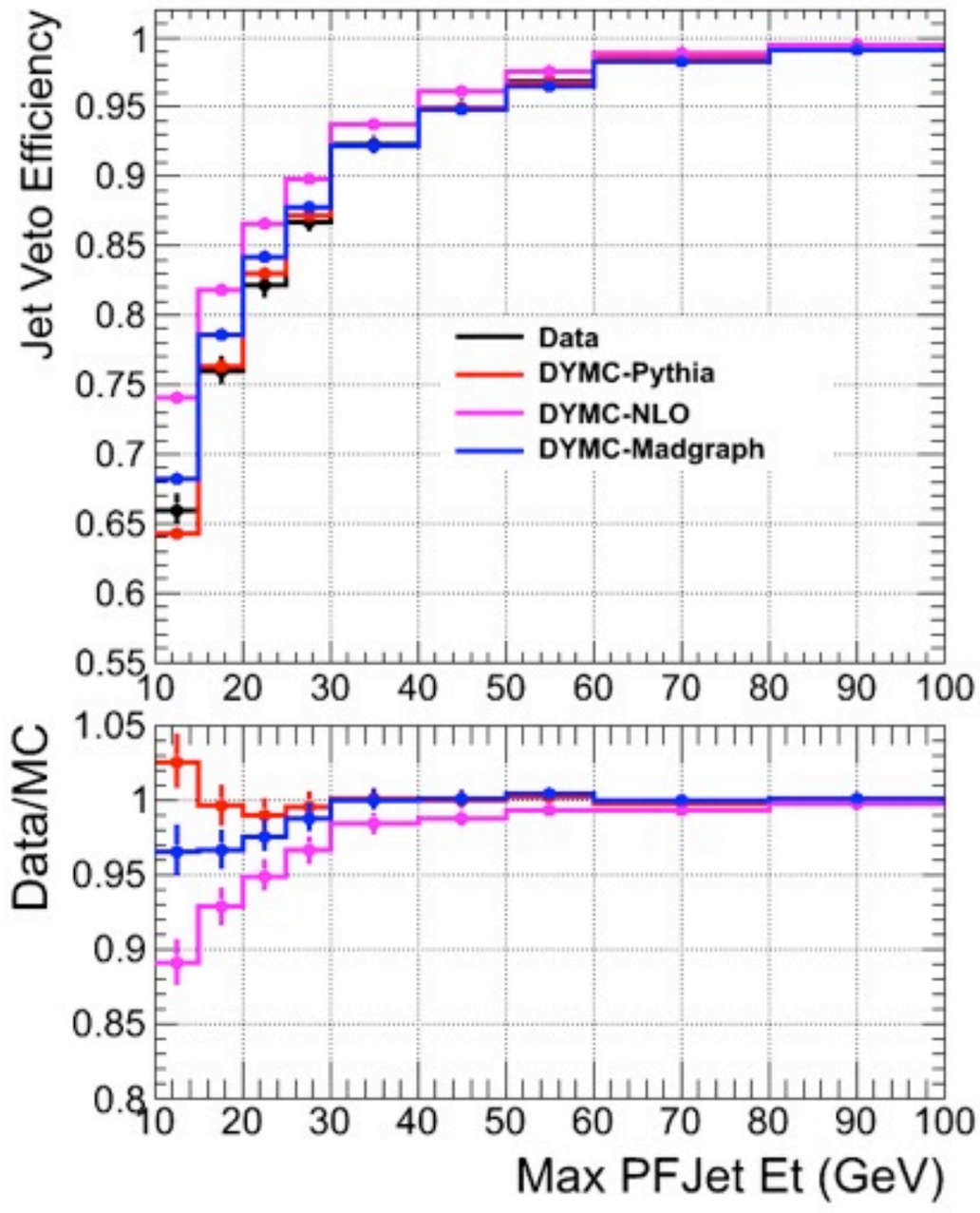




- Data/MC agreement is ~ 99% for Pythia and Madgraph at 20 GeV
- This is confirmed with JPT and Trk Jets
- It is safe to increase the jet veto to |eta|<5

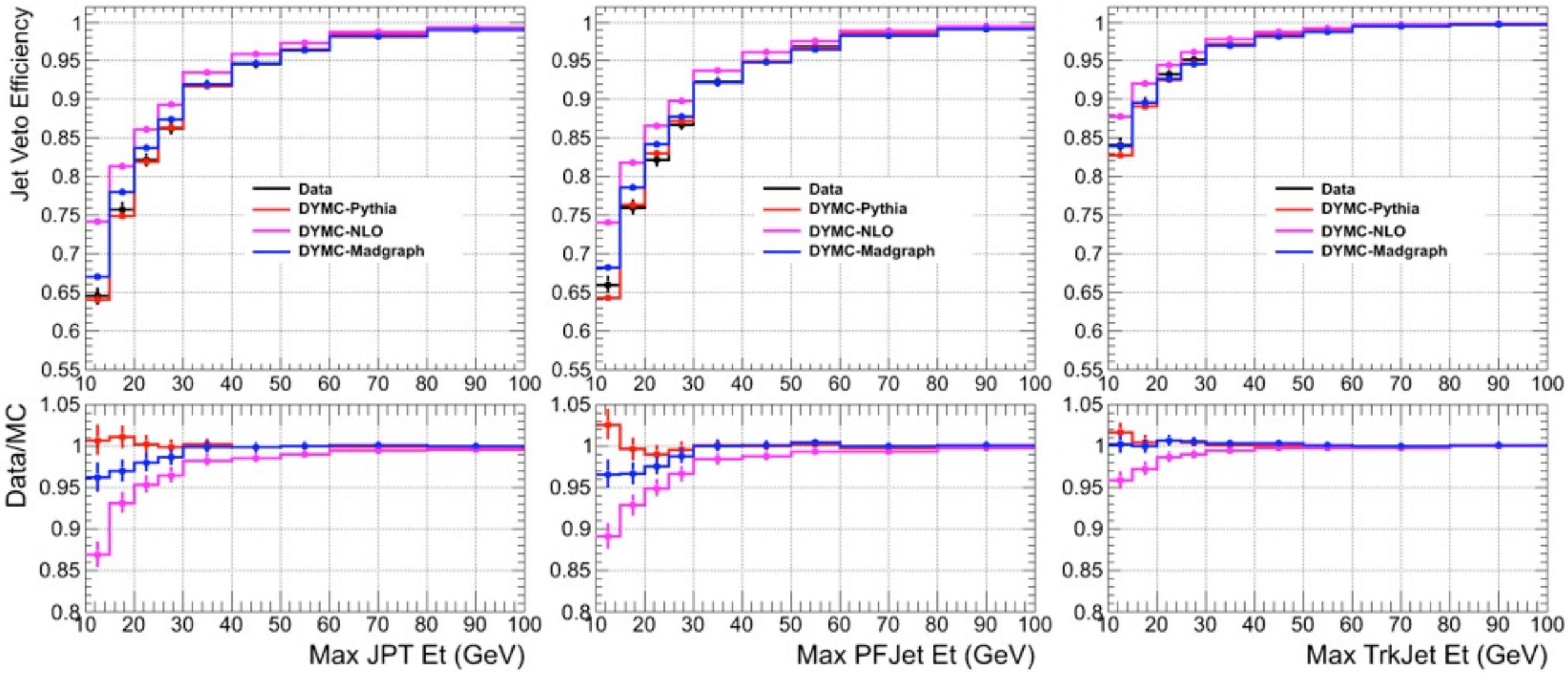
PF Jets |η|<5 (EE+MM)





- NLO MC spectrum doesn't agree with data
- Data/MC agreement is ~ 99%(97%) for Pythia(Madgraph) at 20 GeV

Compare 3 Jets |η|<5 (EE+MM)



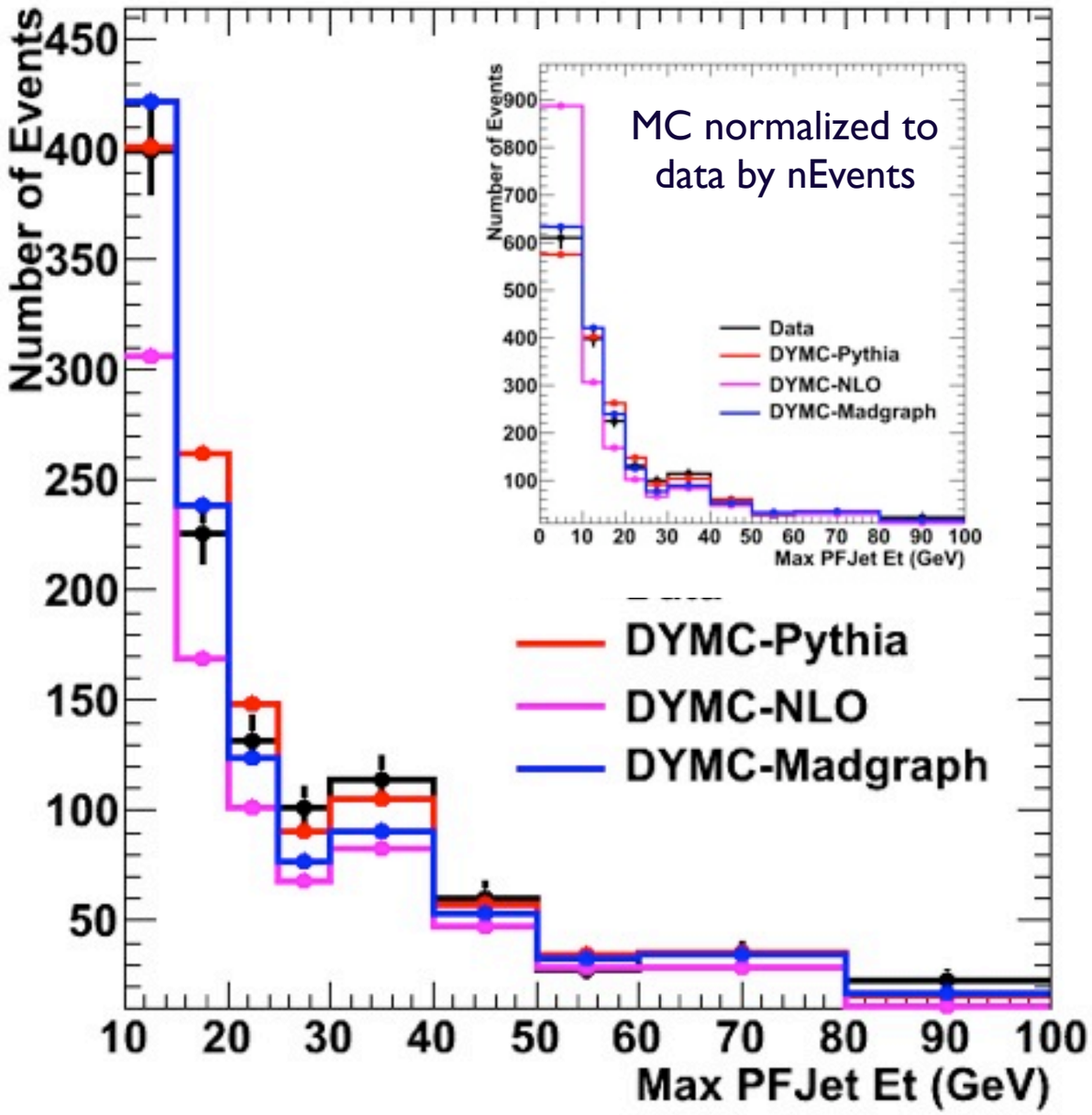
- JPT/PF perform similarly, while the trkJet Et is on a difference scale
- Data/MC agreement gets better as we relax the JetVeto

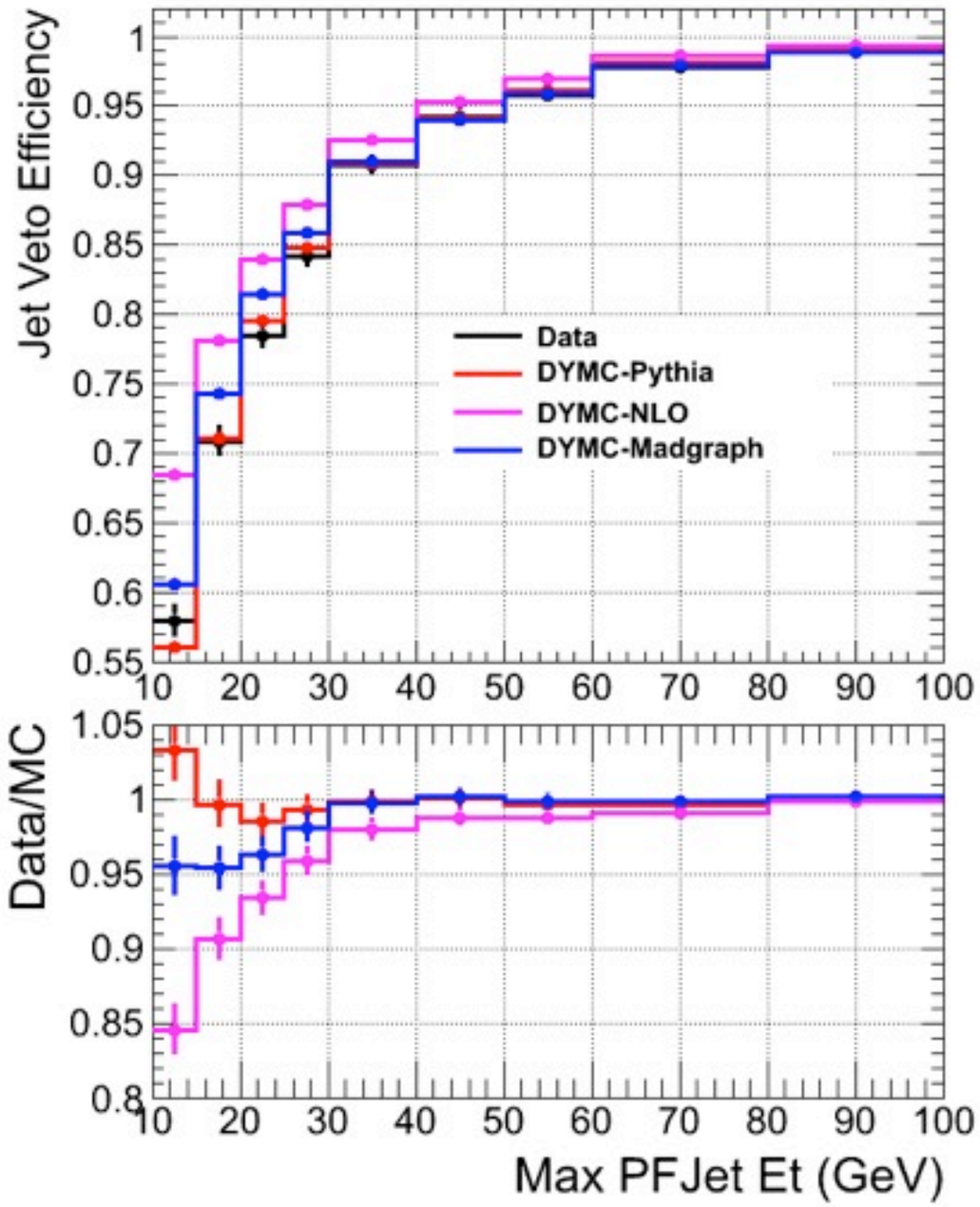
	JPT	PF	TrkJet
JetVeto 20GeV			
JetVeto 25GeV			

Jet Energy Corrections

- Apply L2(Relative)+L3(Absolute) corrections on both data and MC
  - Derived from MC truth, taking care of the bulk of the response
- Apply small residual corrections on data
  - This is a small effect, improving the data/MC jet response
  - https://hypernews.cern.ch/HyperNews/CMS/get/JetMET/1017.html (Konstantinos Kousouris)
  - http://indico.cern.ch/getFile.py/access?contribId=2&resId=0&materialId=slides&confId=99954 (Konstantinos Kousouris)

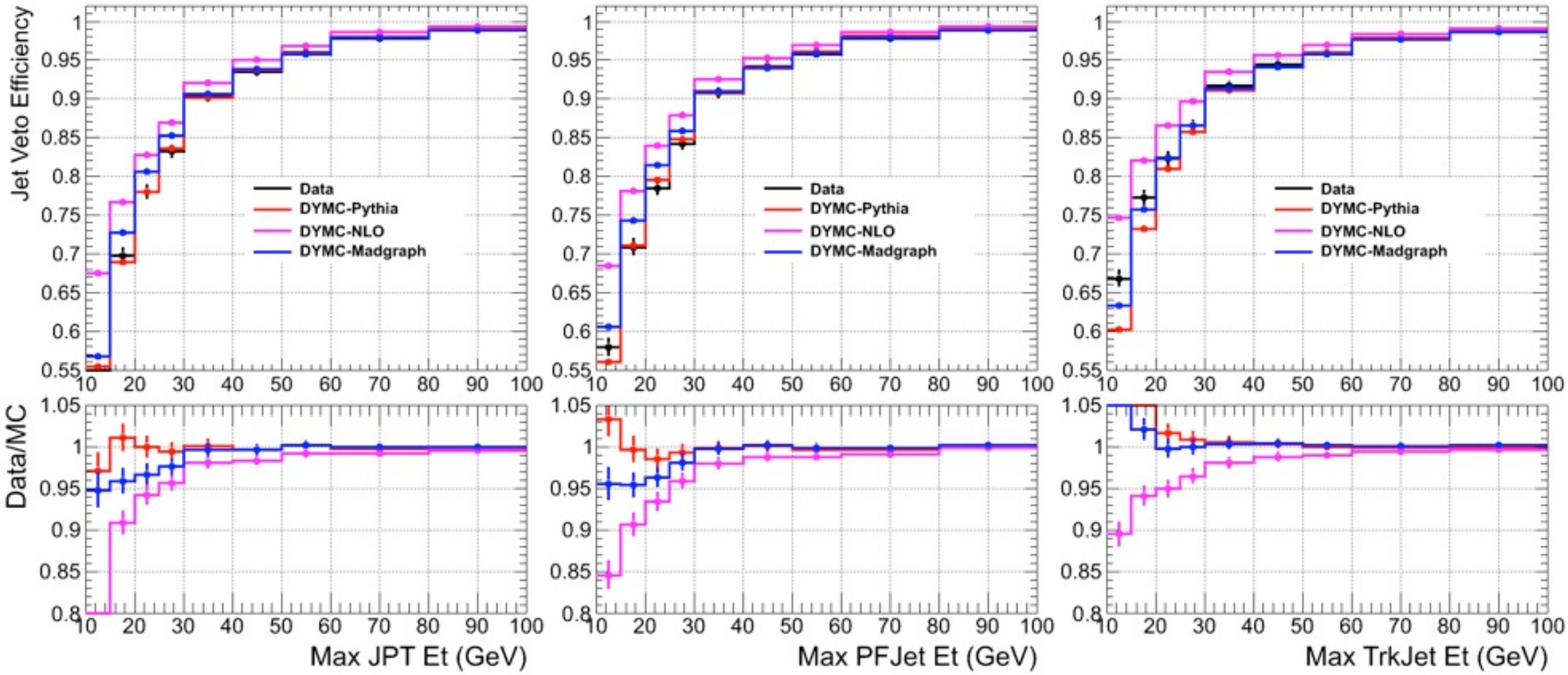
PF Jets |η|<5 (EE+MM) with JEC





- NLO MC Jet Et spectrum doesn't agree with the spectrum in data
- Data/MC agreement is >= 99%(96%) for Pythia(Madgraph) at 20 GeV

Compare 3 Jets |η|<5 (EE+MM) with JEC



- The jet veto efficiency using corrected jets is a few percent less than the efficiency using uncorrected jets (as expected)
- The data/MC ratio in jet veto efficiency using corrected jets is similar to the performance using uncorrected jets for JPT and PF
  - Data/MC agreement is > 96% at 20GeV in all jets

JetVeto Signal Efficiency Uncertainty

- A data-driven way to estimate the efficiency

$$\epsilon_{WW}^{data} = \epsilon_{Z}^{data} \times \frac{\epsilon_{WW}^{data}}{\epsilon_{Z}^{data}} \dashrightarrow R_{WW/Z}^{data}$$

$$\epsilon_{WW}^{data} = \epsilon_{Z}^{data} \times R_{WW/Z}^{MC}$$

  - Main question: how well does the MC reproduces data in this ratio?
    - Choose the MC with best data/MC matching for the nominal value
    - Select the available MCs with reasonable data/MC matching in the control region for variation (Madgraph vs Pythia)
    - Assign the difference of the ratio as the systematic error on $R_{WW/Z}$
      - Pitfall: what if both MCs are wrong in the extrapolation?
      - How well do we understand this ratio theoretically? (QCD)
- Propagate the errors on $\epsilon_{Z_{ll}}^{data}$ and $R_{WW/Z}$ for the final number

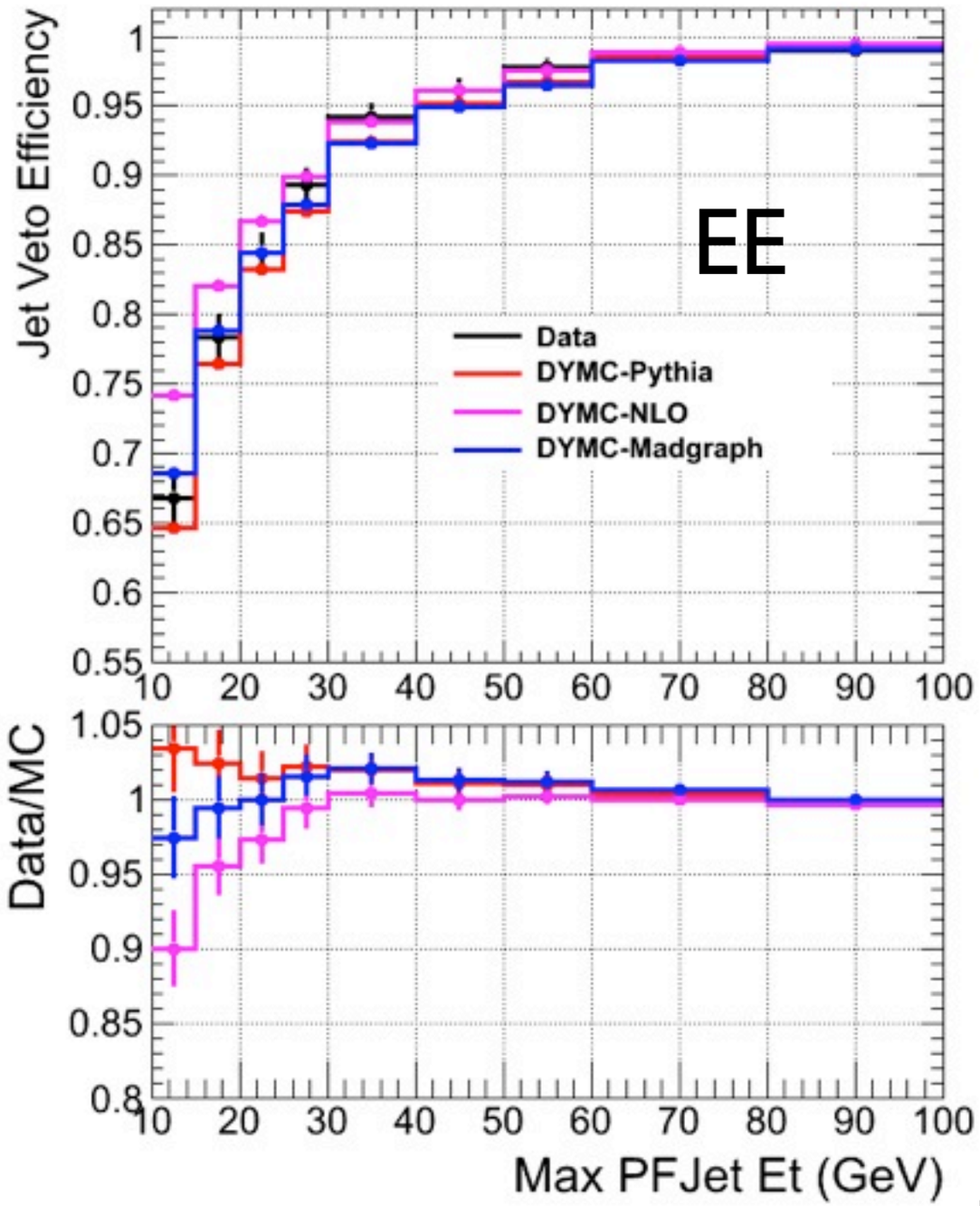
Summary and Plan

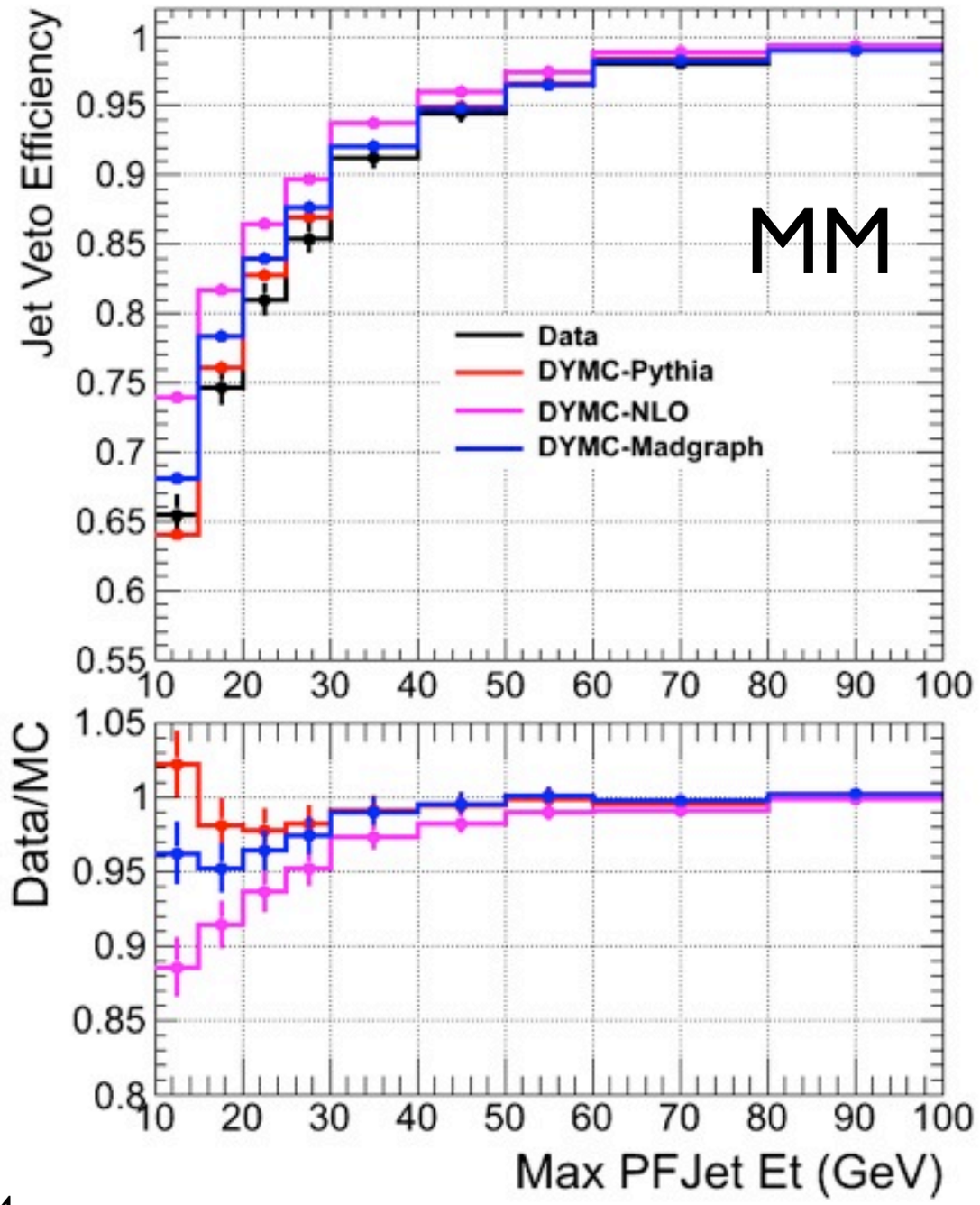
- Summary
  - We compared various jet (PF/JPT/TrkJet) energy spectrums with the Zjets between data and Pythia/NLO/Madgraph
    - The NLO MC Jet Et spectrum is softer than data
    - Pythia/Madgraph MC Jet Et spectrums agree better with data
    - Performance on the L2L3 correctes jets are comparable with the uncorrected jets
  - The JetVeto efficiency in data differs from MC by less than 4%

Backup Slides

JetVeto Efficiency EE/MM

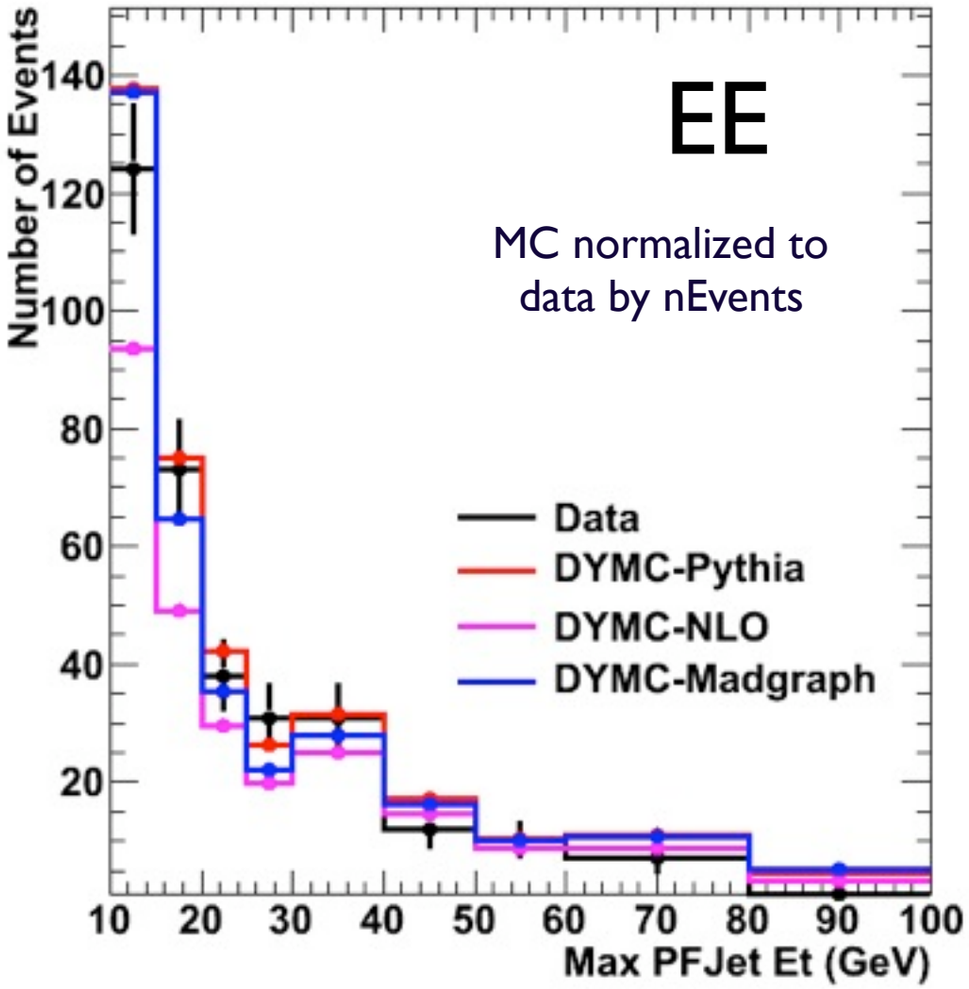
- The efficiency in MM is a few % (not alarming) less than EE
  - We see same behavior in JPT/TrkJet

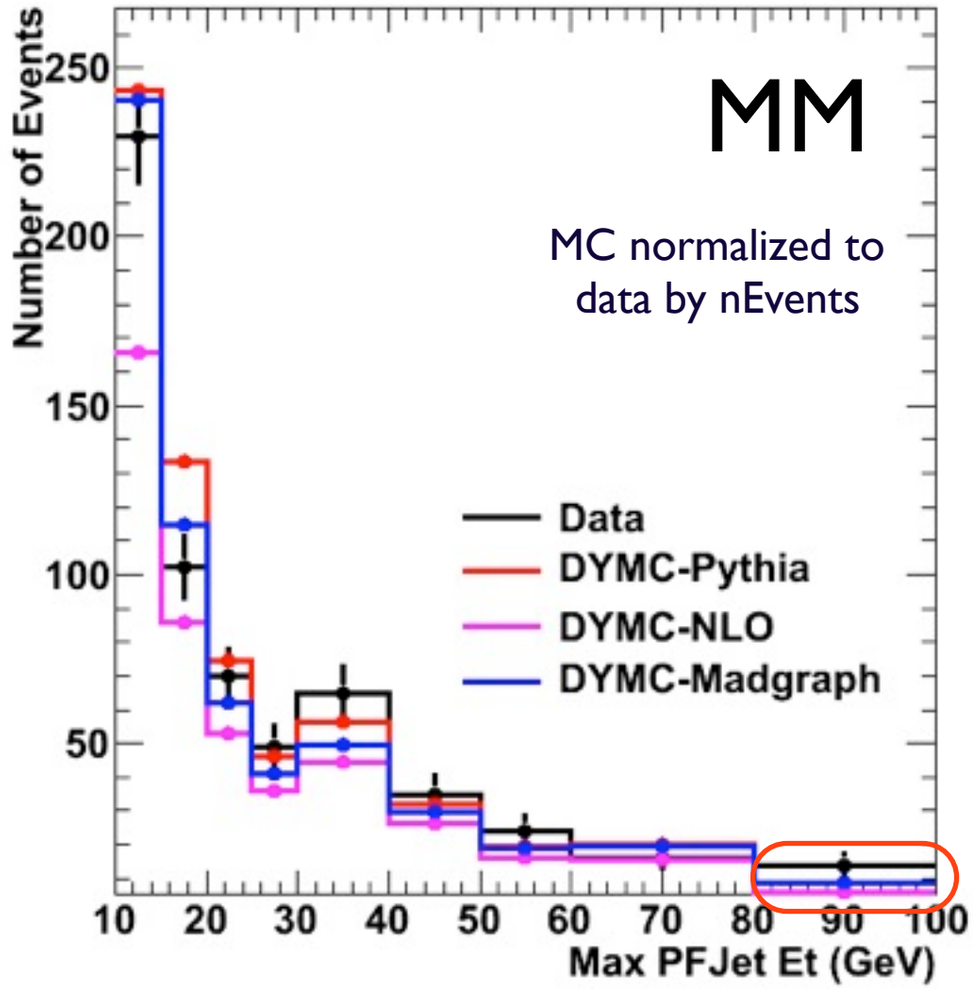




Jet Et in EE/MM

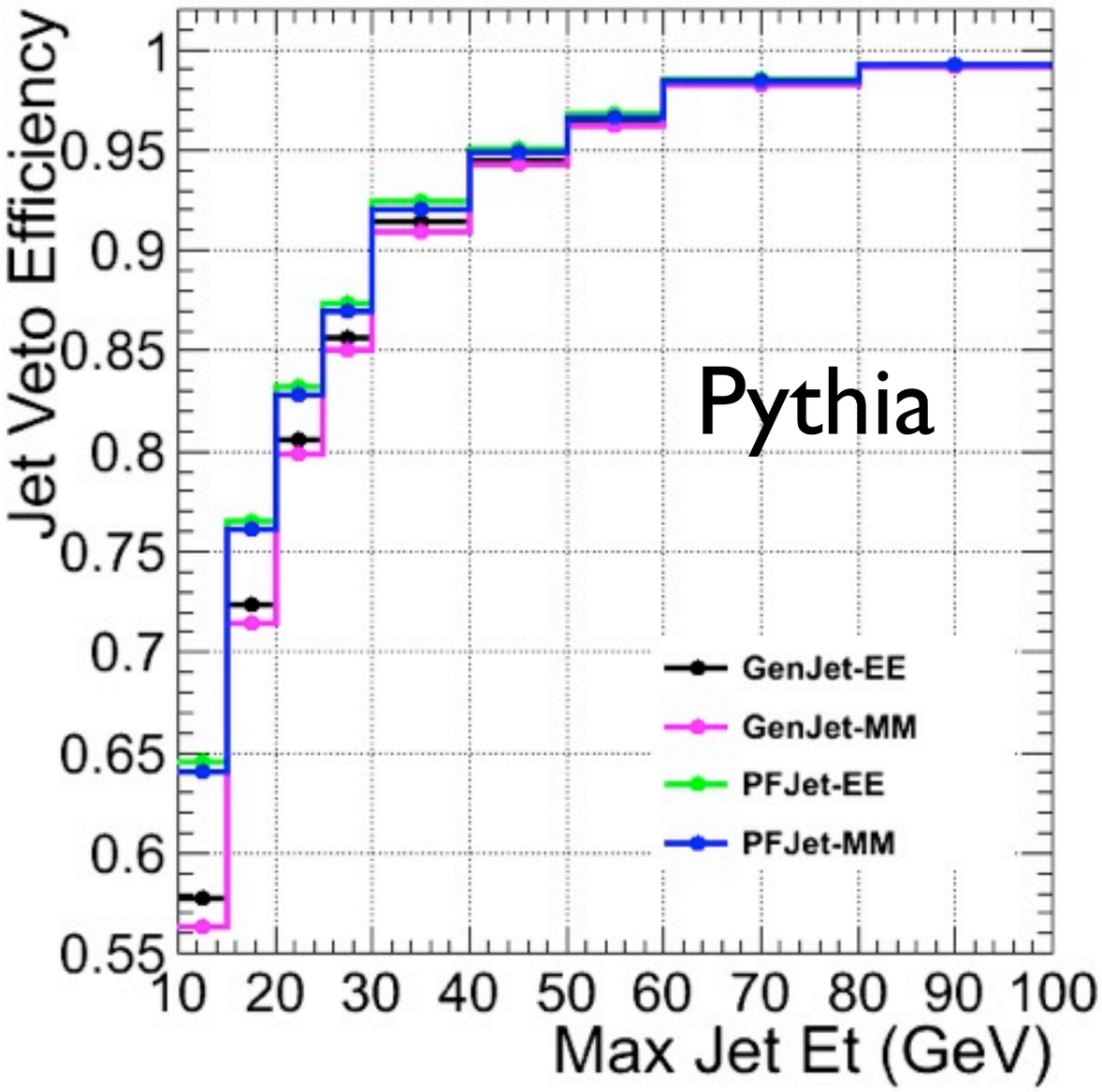
- EE selection is much tighter than MM
  - Number of Events after the Z selection: 629 (EE) 1109 (MM)
  - We see a bit more energetic Jets in MM, but the event count are consistent within statistical errors

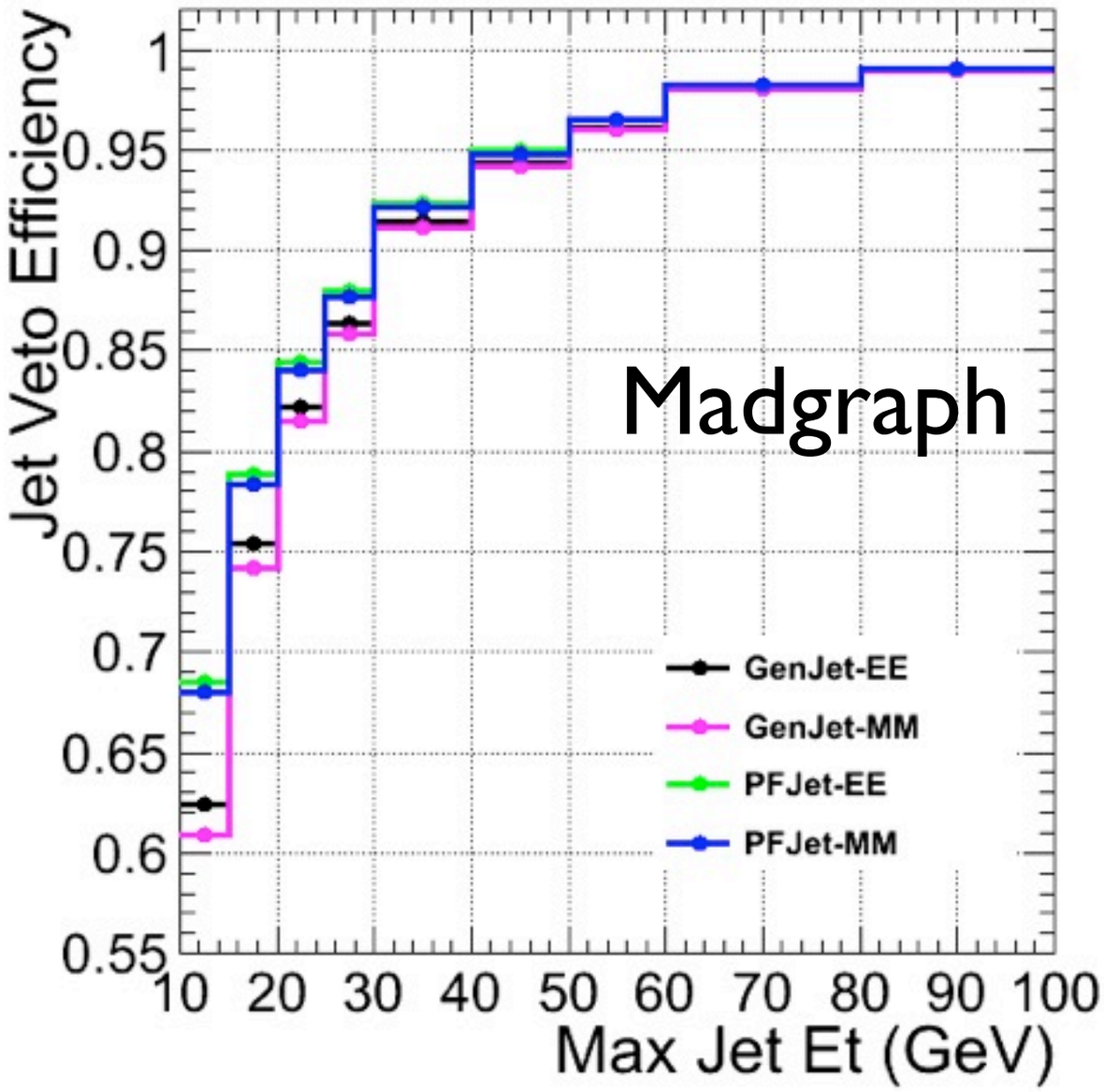




JetVeto Efficiency EE/MM difference in MC

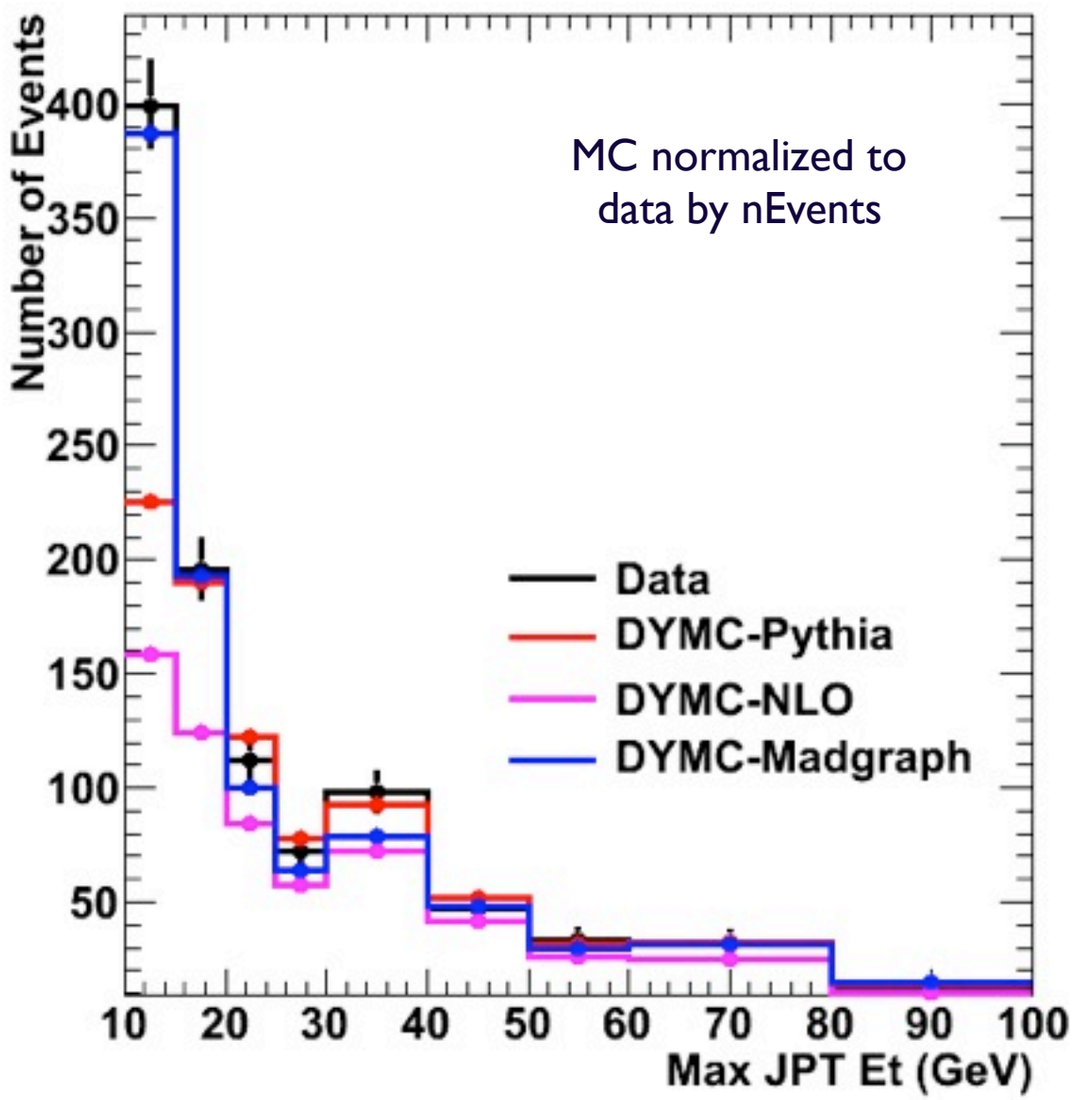
- EE/MM difference is <1% for GenJet, and even smaller with PF

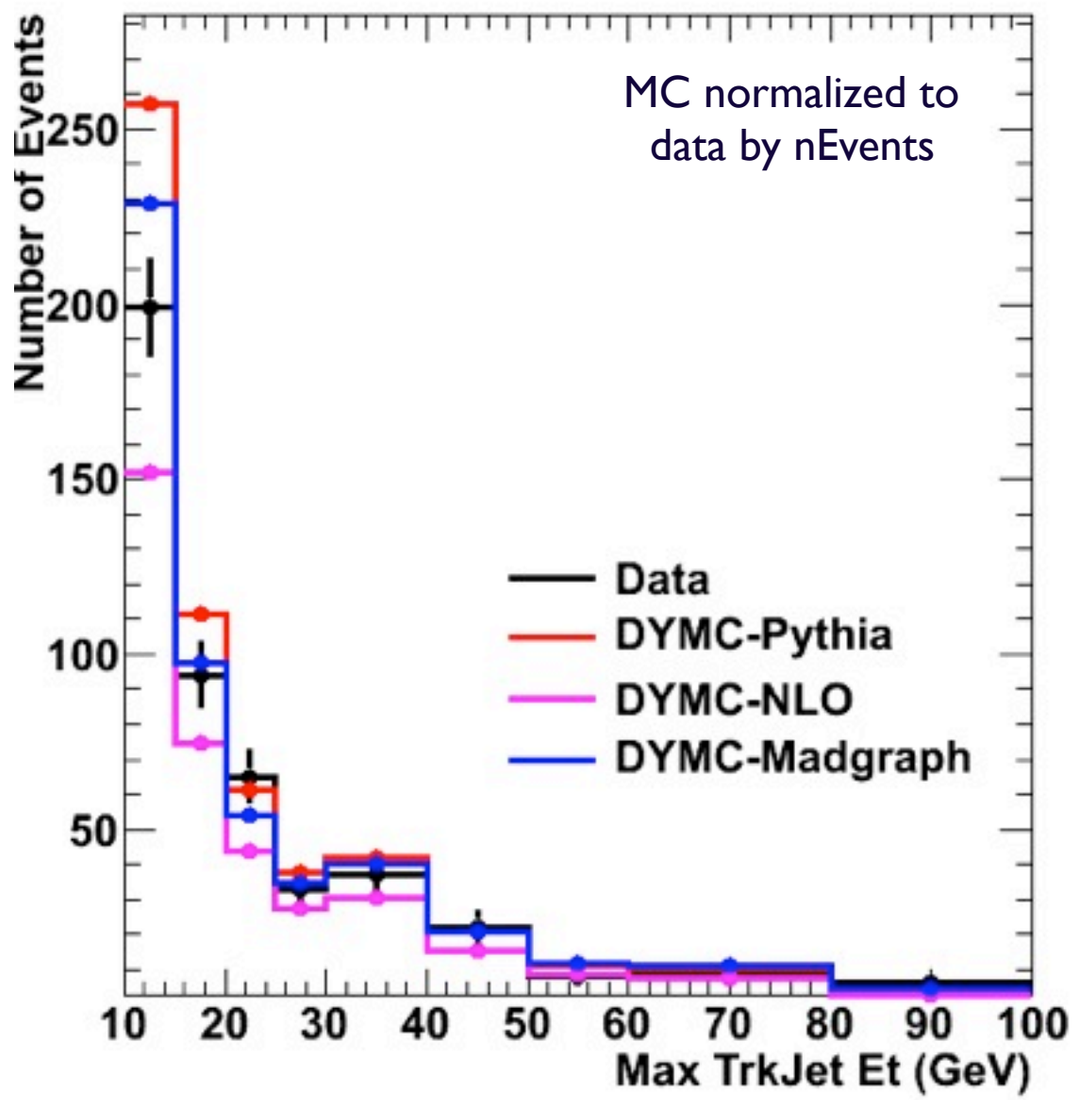




JPT and TrkJet Et

- ..





CaloJet Performance Uncorrected

- The large efficiency is due to the large 0 bin value